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THE CHANNEL RAILWAY.

JAMES CHALMERS.

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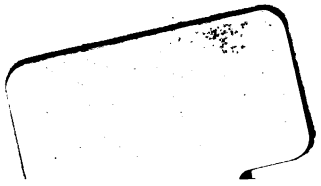


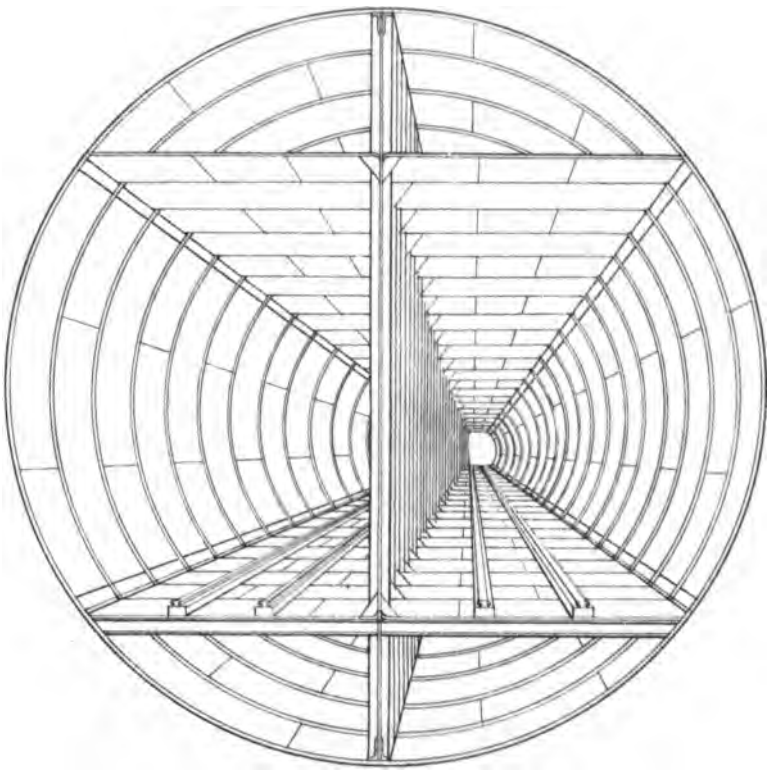
THE CHANNEL RAILWAY,

CONNECTING

ENGLAND & FRANCE,

BY

JAMES CHALMERS.



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THE CHANNEL RAILWAY.

CHAPTER I.

INTRODUCTION—THE VALLEY.

GLANCING over the Railway Map of Europe, the intelligent eye traces clustering lines tending to certain points; and, on following them, finds they almost invariably centre in some great city. It cannot fail, however, to notice a remarkable exception to this general rule: on the Continent, from North, East, and South, and in England from South, West, and North, lines are seen drawing together apparently by some attraction, stretching out their iron arms as if they would embrace, when, lo! they have stopped. There is no great city at either of their chosen termini: there is a valley between them; but such a valley as Railway Contractors would delight to make a road through. The land is cheap in that valley, the gradients easy, and the ground firm; but, alas! it is part of the dominions of an old monarch who strenuously refuses to grant the right-of-way, and seeks to impose upon others the restriction originally placed on himself—"Hitherto shalt thou come, and no farther." Strong hopes, however, are now entertained that this valley may be crossed, and the converging lines united.

There are three ways of effecting Railway communication between England and the Continent:—Through the earth by tunnelling under the bed of the sea; through the water within submerged tubes; or through the air on a bridge.

Before proceeding to introduce my project, I will briefly notice a few of the schemes that have already been before the public; and

I do this for the following reasons:—To show how long the idea of roadway communication has existed; how earnestly the accomplishment of this great work is desired on both sides of the Channel; to illustrate the increasing interest that scientific and practical men are taking in the matter; and to enable the reader to compare or contrast the projects of those who have preceded me with the one now before him, in order to judge whether or not I claim too much for mine, in asserting that it is the only practicable method yet proposed for connecting the Railways of England and France. There have been before the world, to my knowledge, twelve projects for this purpose, including the present; and, judging from the names, seven appear to be French, five English; but, if that of Mr. De la Haye, of Liverpool, be classed with the latter, there are then six of each nation. Three projectors, all French, proposed tunnelling under the Channel; seven, two French and five English, propose submerged tubes; a Frenchman proposes an arched roadway, or tunnel, *on* the bottom; and an Englishman, a mammoth bridge.

The idea of tunnelling is much the oldest; a French engineer, Mathieu, sixty years ago, considered the work practicable, prepared plans, and laid them before Napoleon, then First Consul: they were some time exposed in the Luxembourg and other public galleries in Paris; but they have long been lost; and there is now, it appears, no account extant of the then proposed method of accomplishing the work. The project of M. De Gamond, also a tunnel, appeared in 1856-7, and may be reckoned, along with others that appeared about the same time, as fruit of the exhibitions of 1851-4.

De Gamond's project, however, received more than ordinary notice. A commission of eminent engineers, appointed to examine his plans, made a favourable report, and recommended an appropriation of £20,000 to make experimental examinations; and the Emperor is said to have looked upon it with favour; but, notwithstanding the high countenance he received, and the ability displayed in his work, it was finally rejected, on account of its interference with the navigation of the Straits. His plan, briefly, was to form

in the Channel thirteen islands by carrying material out to sea, dig down through them into *terra firma*, and tunnel east and west.

The submerged-tube projectors seem to have given the subject less study than the advocates of the tunnel (present company of course excepted: I must leave to others the pleasure of pointing out *my* defects). Almost all of them, like Pope's troublesome friends, have thrust their crude and half-digested schemes upon public notice with a polite request to "revise it, and retouch," or, "what you'd have it—make it." There is an easy, gentlemanly indifference about them, an *if*, a *might*, or a *perhaps*, cutting the Gordian knot of every difficulty that comes in their way: let one or two speak for themselves.

I quote from an article, by Mr. Wylson, C.E., in the *Illustrated London News*, in which he gives a *résumé* of the plans of previous projectors: the italics are my own:—

Mr. De la Haye says, "My plan is simply to construct wrought-iron tunnels in separate divisions; to sink them on the bed of the water; and then to connect them. * * * It will be admitted that to construct such a tunnel would be an easier matter than to build iron vessels, as it would be the same shape the whole length; then to sink it on the bed of the water would be the work of only a few hours for each division of 400 feet in length. Perhaps the part of the work which will appear the most complicated will be to connect the divisions under water. * * * The operation will be attended with *no extraordinary difficulty to those who can remain during half an hour in deep water.* * * * As regards that part of the tunnel which would be near the shore, it would be sunk under ground, and covered with stones fastened together, so as to render them immoveable. * * Then the railway will be formed in forming the tube; there will be no hills to cut through, valleys to fill up, or arches to build; in short, the sum total of the work is comprised in the tunnel itself.

"Supposing the divisions to be 1000 feet in length:—

"In that case, only 104 divisions would be required to join the rails of the South-Eastern Railway with those of the Calais and

Paris. Now, *supposing* each of these divisions would cost £40,000, the cost of the whole would be £4,160,000; and if we allow for the expense of *throwing* them in deep water, of connecting them, of building stations, &c., on a magnificent scale, it will, *I believe, be found*, that the sum of £8,000,000 sterling would be quite sufficient to complete this submarine railway."

The manner in which this gentleman speaks of *throwing* into *deep* water, iron tubes a thousand feet long, capable of containing a full-grown railway, is perfectly refreshing. This extract gives no idea of his method of keeping them on the bottom after he gets them there. Another "project consists in crossing the English Channel, twenty-one miles in extent, by means of a tube made of strong plate iron, or cast iron, lined and prepared for that purpose; and which, placed at the bottom of the sea, should, besides the path for the surveyors, contain the two lines for the trains which would run within it. *The slope given to the submarine railway would admit of a motion sufficiently powerful to enable the carriages to cross the Channel without a steam-engine.* The greatest depth of the sea at the middle of the Channel will admit of the construction of inclined planes, by means of which the train would be enabled to reach a point where a stationary engine, or atmospheric pressure, *might* be employed in propelling the train to the level of the land railways of France and England. These tunnels beneath the sea would not prevent navigation. Two lighthouses might be erected at the entrances of the tube; also smaller ones between the lighthouses of France and England. These beacons should be lighted up at night, and would indicate outwardly the position of the submarine railway, so that mariners should not cast anchor near it, as the tubes might be damaged. The day and night lights of the lighthouses should be transmitted through the tube by means of reflecting metal plates. The upper part should have some strong glass windows, placed at equal distances, and gas, which would complete the lighting between the beacons. According to an estimate made, the cost *might* amount to *about* £87,400,000." This projector handles his finances as the other does his iron, in large masses, and with the same *nonchalance.*

The next does not place his tube on the bottom, but proposes "to situate it at a uniform depth from the surface by means of ties below (and *buoys* above if necessary), at suitable intervals. The continuation of the tunnel into the shore on either coast *I should dispense with;* and in order that it should have a partial freedom of motion, it should terminate with solid ends before reaching the shores. To these points chain piers should extend; or, if strict economy (say in the first instance), were aimed at in this item, the communication *might be by small steamers.*" As the tunnel or tube in question contains only a single line, the projector proposes "*pushing* one way, and *pulling* the other;" or, he says, "Electricity should, if at all practicable, be the motive power." After proposing, as the principle of construction, something "analogous to the cooper's craft," he continues, "when the tube was completed from end to end * * * favourable weather would be waited for, and the work of lowering would then be accomplished, nearly as follows:—The air-tight interior of each pontoon would be connected by an ample length of flexible pipe to an air-pump of adequate power, on board a vessel anchored at a distance corresponding to that intended for the mooring-weights. The two lines of vessels should be manned by steady men, each crew under a trustworthy leader. Athwart the vessels would be laid from the shore the wires of an electric telegraph, communicating with an apparatus on board of each, so that, at a preconcerted signal, the abstraction of the air from the pontoons should be commenced simultaneously at a given time, and carried on at a given rate. By this means the pontoons, gradually deprived of their buoyancy, would yield to the pressure of their burden, the buoyancy acquired by which as it entered its future element would be overcome by the weights with which, throughout its length, it was loaded, and which would speedily sink it to its prescribed depth. It would be when the tube reached the water that the mooring-weights, having been preparatorily slung under the vessels above-mentioned, would, at another signal by the electric telegraph, be *simultaneously let drop into the sea, and drag down their charge along with them.*" This project, which contem-

plates a tube not 1000 feet but 20 miles long, contains only a single way, and stops short of either shore, will cost £15,000,000, even with iron at £20 per ton; and yet, it goes more into detail, and is more complete as a whole, than any project on the tubular principle that has come under my observation. Whatever be its merits or defects, it fails to supply the great desideratum; it does not remedy the serious inconvenience which the immense increase of trade and travel in this direction renders daily more oppressive, viz., the necessity for employing three vehicles instead of one, in carrying goods and passengers between the capitals of the two countries. In a subsequent reference to his scheme, this projector says, "I am gratified by the opinion of a practical engineer regarding the practicability of the plan. I think it likely enough that the ironwork might be done for £16 per ton, but I chose to take a full figure:" surely, if £20 per ton is a full figure for a tube 20 miles long, consisting of seventy hollow staves of a peculiar and difficult sectional shape to make, £25 must be an extravagant estimate for plain tubes in manageable lengths, as I propose to make mine.

The proposer of the arched roadway, or tunnel *on* the bottom, will, with 40 subaqueous boats (of which he is the inventor), 1,500 sailors and navvies, 4,340,000 cubic yards of material, and £10,000,000, undertake to construct a tunnel by means of which the Straits can be crossed in thirty-three minutes; and he of the mammoth bridge will make in the Channel 190 pedestals, 300 feet square at the bottom, consisting of rocks bolted and lashed together, gradually rising at an angle of 75°, till they form each an insular plain, 150 feet square, 40 feet above the level of the sea; on these, build towers 100 feet diameter, 260 feet high; and crown the whole with a tubular bridge 50 feet deep and 30 feet wide.

When I began to devote attention to this subject, the extent of my knowledge of previous projects was derived from a humorous article in *Chambers's Journal*, entitled "The Channel Bridge," in which the writer notices De Gamond's tunnel and the Mammoth Viaduct. I had not then heard of any tubular proposition; and

my ignorance on that score was doubtless an advantage to me. I was free and unfettered by the opinions or plans of others. Nothing, however, has tended more to strengthen my faith in my own project than the study of the works of others on the same subject. If scientific and practical men give it such careful examination as I have given the plans of those who have preceded me, they will find it not only practicable, but comparatively easy of accomplishment. I do not blink or under-estimate the difficulties of a work so extraordinary, new, and untried: on the contrary, the fulness of my details, and completeness of the provision made for every contingency, will, I am confident, satisfy the careful reader that I have fully studied and appreciated the great difficulties to be encountered. My first and greatest difficulty may be to get scientific and practical men to notice it at all, or give it an attention commensurate with the greatness of the subject; or even such as the humble but earnest labour I have bestowed upon it justly deserves. The fact that many crude and visionary schemes have been long before the public is against me. Some cursory readers may class mine as another of the same stamp; but there is an encouraging set-off in the changes that have taken place since these projects were published: new commercial treaties and greater freedom of intercourse have increased both trade and travel in this direction; and the necessity for this work has now become so urgent, that if it be found at all practicable within reasonable expenditure, its accomplishment cannot be long deferred. The simple greatness of the enterprise, and the immense interests connected with it, will command for my plans some attention; and men whose opinions are really valuable will not stumble at the fact that I am no professional engineer. My lot is happily cast among a people who hold fairplay to be of Divine extraction, who judge the man by his work, not the work by the man. The highest engineering diplomas, especially in our own country, are often those of Heaven's granting. The elder Stephenson, Locke, and many like them, would have stood a poor chance in any other. Besides, I ask for my project no more consideration than its intrinsic merit deserves; nor do I wish to

shelter it behind the greatness of the subject, or the necessity felt for its accomplishment. I have however, one favour to ask of those whom interest, curiosity, or other motives, may induce to examine it—namely, not to judge it by the literary ability of its present advocate. The favourites of Academus, children of wealth and comfort, reared behind the "sheltering wa's and bields" of Eton, Harrow, or Westminster, Oxford, or Cambridge, may easily demolish the rude logic of one who gathered his scanty lore in humble life. Some of the great poets are said to have had in their sanctums pigeon-holes labelled with the letters of the alphabet, and the moment a grand or beautiful thought was conceived, it was committed to writing, and the slip deposited in pigeon-hole A: at some leisure hour, when the inspiration that gave it birth had passed away, it was revised, corrected, and transferred to B; and after another rest and revision, it passed to C; and so on through the alphabet; when, having run the gauntlet of the twenty-four, it went forth into the world to elevate or charm the minds of men. Having no pretensions of a literary character, I have not subjected my composition to such an ordeal; but the alphabet is too short to convey any idea of the rigid, searching scrutiny and study which I have given my project. Many months ago, I had forty-seven sheets of drawings and sketches, labelled and put away. I have bent the whole energies of my mind to improve and perfect my plans, and now fear no examination, except the one they may never receive, or the cursory glance that enables a critic to select a few points for condemnation without taking the trouble of mastering the whole subject.

CHAPTER II.

THE PROJECT.—CAPABILITIES.—PRINCIPAL FEATURE.

My project for the Channel Railway embraces an unbroken, double line, connecting the railways of England and France by easy gradients, capable of carrying all ordinary trains at the usual speed on the best roads, and of insuring perfect safety and comfort. It will enable the Railway Companies of the respective countries to carry their passengers and freight between Paris and London, and *vice versâ*, without change of carriage or locomotive. It offers no obstruction to the navigation of the Channel, differing in this from most of the propositions already before the world; and its shore embankments will form excellent harbours of refuge on either side, that on the English protecting the harbour of Dover from the storms of the North, and the Southern entrance to the Downs from those of the South. The whole work can be completed in three years, on a scale commensurate with the greatness of the countries connected for £12,000,000 sterling.

The principal feature of the work is simply a strong iron tube reaching from shore to shore in the still depths of the Channel, beyond the influence of the storms that render the sea dangerous on the surface. It is supported by its own buoyancy, having a powerful tendency to rise; and is kept down by anchors or boxes attached to and surrounding it and filled with rough stone, both boxes and tube being covered by an embankment of similar material; and, as the current alternates up and down Channel with the rise and fall of the tide, the silt of the bottom carried by it against and into this embankment will fill up the interstices, and in a few years convert it into a solid impermeable mass having the appearance of a ridge reaching from shore to shore, about 150

feet wide at the base, 40 feet high, and from 40 to 120 feet below the level of low-water. In short, the materials of which this embankment will be formed, are the same as the French engineer proposed to use in forming his islands, through which he intended to penetrate to the bottom of the Channel.

The tube will pass through three ventilators, one in mid-channel, and one about a mile from either shore: thus the main portion of the work will be 18 miles in length; and this divided by the deep-sea ventilator gives two sections of 9 miles each; consequently, a train can never be more than 4½ miles from an opening; and from this point will be carried to each opening flues connecting with a chimney rising nearly 300 feet above the level of the roadway at the middle, and 200 feet at the other ventilators; and to insure sufficient draft to clear away all smoke and foul air, powerful machinery will be employed, if necessary, to force air to the parts most distant from the ventilators; which, returning along the flues, will carry away the smoke and vapour left by a passing train, and keep the atmosphere within the tube pure and pleasant; while the cleanly-painted light-coloured iron, and a thousand double lamps — one every 35 yards, will give a cheerful aspect to this ocean roadway, and render it an agreeable contrast to the noise and damp and darkness of an ordinary tunnel, or even the miles of uninviting scenery that often meet the eye in broad daylight. The noise in this tube can be reduced to the minimum; unlike tubular bridges suspended in the air, the sound and vibration of the iron will be deadened and neutralized by the equability and elasticity of the pressure without; and, as the situation of the roadway will admit of a perfectly-united rail, the sensation travellers will experience on entering the Channel Railway will be akin to what we feel, after walking on a gravelly road with thin shoes, when we step upon the downy sward of a smooth green lawn.

The form of the tube is circular: it is made of iron plates similar to those used in building boilers or ships: the plates will be double-riveted and caulked; and the tube will be divided

throughout its whole length by the vertical partition C., Fig 10, made of similar plates; thus forming two roadways, one for eastward and one for westward traffic (*see* Vignette on titlepage). It will be further strengthened by two horizontal subdivisions—the girders, 6 feet from the bottom, and the ceiling, E E. The ends of the central partition, the girders, and ceiling being connected with the tube at six points nearly equidistant, will effectually preserve its circular form. It is still further strengthened by ribs or circles of strong T-iron, H H, rivetted to the plates, and forming unbroken arches within the tube. The partition is also supported by the T-iron, D D, and the ceiling has similar supports on its upper surface. The plates are calculated at 36 inches wide, lapping 3 inches, and two circles of T-iron are calculated for each plate; but I propose using three for deep-water tubes, two for medium, and one only for those in shallow water near shore: thus, with three ribs of 5-inch T-iron to each plate, the space between the top tables, or part of the T-iron rivetted to the plates, will only be 6 inches, or 11 inches from centre to centre of the ribs—the T-iron and laps exactly equalling in extent the interior surface of the tube, thus, as it were, doubling its thickness, and, by the form adopted, more than trebling its strength. The interior supports just described—the partition, girders, and ceiling—sustaining the tube at six points of its circumference, and the exterior support it will receive at ten points of its length from the sides of the iron boxes attached to, and surrounding it, will render it the strongest and most economical tube that can be made to resist the combined forces of compression and lateral strain. These tubes may be built in any harbour, or on the banks of any river, in either country, within reasonable distance of their destination.

The ventilators will be circular masses of iron and stone, of which a detailed description is given hereafter: the one in mid-channel, when finished, will weigh over 100,000 tons, and displace 58,448 tons of water; the depth where it will be placed being 28 fathoms, = 168 feet: about 50 feet from the bottom, it will be surrounded by, and embedded in the embankment that covers the

tube; and, as the storms that trouble the surface of the waters do not agitate them to a depth of more than 30 feet, 138 feet of the height of this massive tower will be surrounded and sustained by a weighty body of water in a quiescent state; and that portion of it exposed to the action of the sea will have little to withstand: the waves are only powerful when resisted: around the smooth iron sides of this round structure they will part and pass onwards: they will have four directions in which to expend their strength—upwards, downwards, and on either side; and the upward spray will be thrown back into the sea by the projecting curve with which the wall of the ventilator finishes above. The other ventilators, of similar construction, will stand in 12 fathoms, about a mile from either shore: the tubes will be attached to the ventilators near the bottom: those connecting the ventilators with the shores will be covered by an embankment rising above the level of low-water, effectually protecting them in the shallow waters near shore from contact with ships or injury from any other cause. From the point where the tube connects with the shore, a tunnel will be driven to that selected for the entrance.

CHAPTER III.

ILLUSTRATIONS.—DEEP-SEA VENTILATOR.

FIG. 1, Section of Channel, showing roadway, ventilators, deep-water and shore embankments. A and F, entrances; C, D, and E, ventilators.

Figs. 2, 3, 4, 5 and 6, deep-sea ventilator. Fig. 2, elevation: V, ventilator or chimney; B, lighthouse; C, dome, constructed of iron and glass, which may have doors, or other openings to open and shut at pleasure. The bottom of upper gallery, A, will be grated, excepting at F F, in Fig. 5, the gratings opening into interior of dome, for light and air. This ventilator will be constructed of iron and stone, as shown in the plans, Figs. 4 and 5, and section, Fig. 6. The bottom, P, is double, the plates 3 feet apart, connected by ribs crossing each other at right angles, as shown in Fig. 3, the cells between the ribs being filled with concrete: it is further strengthened by 14 iron ribs, 7 each way, 10 feet high, crossing each other at right angles, and reaching from the concrete bottom to level of roadway, as seen in Fig. 6: the cells, or spaces H, between these ribs being to receive drainage. The superstructure consists of two iron shafts, D and E, Figs. 3 and 6, properly connected and stayed: when floated out and correctly placed, the space between will be filled with masonry, as shown in Figs. 4, 5, and 6. I propose to build this ventilator (say at Deal) in the following manner:—The bottom, 132 feet in diameter, will be laid down in such a position as to admit of the ventilator being launched into 4 or 5 fathoms of water: the bottom will then be built, filled with concrete, and the work continued until the ventilator attains a height of 80 feet: at this height, with upwards of 1000 tons of scaffolding and material, it will draw 19 feet of water.

A level bottom having been selected, or prepared, in a comparatively sheltered place in the Downs having about 6 fathoms of water, it will be launched and floated till over the place selected; then sunk, by admitting the water. The construction will then be continued, scaffolding being erected inside, until it reaches the height required, when it will be emptied of the water, and towed to its position in the Channel; and will be capable, as a vessel, of carrying, besides its own weight, 5000 tons of material for other parts of the structure—drawing 30 feet of water. On reaching its final position, a level bed having again been selected or prepared, it will be sunk by the admission of water; and if, on touching the bottom, it is not accurately placed, pumping out water will restore such measure of buoyancy as may be necessary in order to adjust it; and, when properly adjusted, the water will be readmitted. The stones to be used in filling with masonry *the upper half* of the space between the shafts, D and E, will now be lowered into the interior of the inner one; and when the ventilator is sufficiently ballasted by this means, the water between the shafts, D and E, will be pumped out, and the work of building the masonry between them proceeded with: when the lower half of this is completed, the water in the inner shaft will be pumped out, and the stones, that in commencing were placed therein for ballast, employed in building the upper half of the wall. Fig. 5, shows division of interior into flues, F, for the ventilation; R, rooms for work-people; and S, stairways. Fig. 6, vertical section of ventilator and portion of tube, showing connection of ventilator with air-channels, F, in upper part of tube, &c.; V, ventilator proper, or chimney; B, lighthouse, which may either have four or more fixed lights surrounding the chimney, or one light travelling around it on a circular railway, thus forming a revolving light; C, interior of dome; F, flues connecting tube with chimney; G G, level of roadway; H, cells under ventilator for receiving drainage, whence it would be pumped out; I I, joinings of tube on each side of ventilator; I K, one length or section of tube; L, space in tube for drainage, and air-pipes (if required) under roadway: the tube will be covered throughout its

length by the embankment N, of which a cross section is shown to the same scale in Fig. 7: each section of the tube, 400 feet in length, will also have attached to, and surrounding it, five chambers or boxes, A A A A A, which will receive a sufficient portion of the embankment or loading to retain it in its place, independently of the material that will be placed around and over it: the form of these boxes will be seen in Figs. 8, 10, and 12: their greatest length is horizontally across the tube, and is 60 feet at bottom, and 40 at top: their height is 33 feet, and width 12 feet: they are made of iron plates rivetted and stayed but not necessarily water-tight: the top, B, Fig. 12, is open, to admit material; and is strengthened by a frame of timber inside, bolted to upper edges: the bottom is partly open, to allow materials to pass through and form an even and solid bed beneath it on the bottom of the Channel. When the latter is found to be uneven where a joint is to be made, blocks of timber, as shown under O, Fig. 6, will be bolted to the bottom of the box to prevent it from sinking too far, and to enable material to pass through, and fill up the inequalities beneath.

Fig. 12 shows a length of tube with boxes attached; and is intended to give an idea of what each section will have to carry when floated to its site.

The tube, as already stated, will be constructed in lengths of 400 feet each, and launched and towed to their positions: each length will be furnished with temporary bulkheads as shown at C and D in Fig. 9: there will also be interior divisions to regulate the space to be filled with water in submerging: for, during this operation they will be made to retain a portion of their buoyancy, and be drawn down by means of chains passing through pulleys attached to massive anchors on the bottom of the Channel: the chains will be made to indicate, by change of colour or otherwise, the progress of descent: the anchors will be four in number, and so placed that their respective chains will be attached to the outer corners of the bottoms of the end boxes: the length of tube will thus be secured at its four extreme corners; and the other ends of the chains will be connected with machinery on board vessels, which machinery, when set in motion, will have a uniform speed, causing

the tube to descend in a perfectly horizontal position; and, as the pulleys through which the chains pass will be so arranged as to retain the portion of chain that passes through them—allowing no back-slip, the tube in descending will gradually acquire the steadiness of the bottom of the Channel, getting rid of the unsteady motion of the surface. When a length of tube has been safely submerged, a supplementary chain having previous to submersion been attached to—will disengage a key that secured the submerging chain to the corner of the box; and being also attached by a longer branch to the submerging chain, the submerging chain will by this means be brought back to the surface; for the latter being then slack will drop into a recess below the pulley (which revolves only one way), through which it can be withdrawn without the pulley revolving.

In commencing to submerge a length of the tube, a wire cable attached to end of bolt, H, Fig. 11, is passed through the projecting portion of the flange, B, while the tube **U**, is on the surface of the water, the end of the bolt being previously fastened inside of the tube, **T**, already in its place and loaded down: a strain is kept on this cable—in nautical phrase it is kept taut,—while tube **U**, is descending; and on its nearing its position, the bolt, H, guides the flange, B, till the projection rests on the cone, C, surrounding the bolt-hole in flange, G: the projecting upper half of flange, B, being a semi-circle; see BB, Fig. 10, overlaps and rests on flange, G, Fig. 8, guiding the ends of the tubes together, when they are joined as shown in Fig. 9.

Tube, **T**, Fig. 9, being in its place and loaded down, is empty inside of the bulkhead, C; and tube, **U**, having been brought into its place in the manner already described, it will be seen, by means of strong plate-glass dead-lights in the bulkhead, C, aided by powerful reflecting lamps, when the flanges, F, come together: then valve, E, is opened, allowing the water between the bulk-heads, C and D, to escape through tube, **T**; and, the end pressure on tube, **U**, forces the flanges, B and G, together, with a power of about 2000 tons, or 500 lbs. per square inch of bearing surface; and, these flanges being provided with some elastic substance between them,

a water-tight joint is thus effected: workmen then pass into the division between the bulkheads, C and D, and, by bolting flanges, F, together, make a permanent joint: while this is being done, tube, U, is loaded down; and when sufficiently loaded, the bulkhead, D, is removed, and the operation repeated at the other end, which is furnished with a bulkhead and valve the same as C and E, in tube T; and so on till all are joined together. After the joint is made the bolt H, Fig. 11, is withdrawn and the hole stopped.

The tubes are joined to the ventilators in the same manner as they are joined to each other,—the ventilators being furnished with the necessary bulkheads, flanges, &c., while in course of construction, and the wire cable attached previous to their being placed in position. The work of joining the tubes will commence at ventilator, D, Fig. 1, and proceed towards the ventilators, C and E, on ascending gradients; thus the water necessary to be withdrawn or admitted in submerging the tubes, will flow towards the deep-sea ventilator, where it will be pumped out; and from this point, air will be forced through pipes to the end or bulkhead of the tube last submerged, in such quantities as may be required; which air, returning towards the ventilator, will create a free circulation, and render the work of joining the tubes an agreeable and healthy employment. Communication will be maintained by telegraph between those employed at this work, and those at the surface of the water; and, as the rails will be laid as the work proceeds, ingress and egress to and from the bulkheads will be attended with no inconvenience.

The ventilators, C and E, will be constructed in the same manner as the one in deep water, D, already fully described; and tubes will be laid from them to either shore precisely as described for the deep-water tubes; and the embankments covering them will be continued till they attain a height of about 20 feet above low-water, and a base sufficient to give them a slope of about 35 degrees. Other ventilators can be introduced if necessary where the embankments connect with the shores.

The diameter of the tube, 30 feet, is greater than a double roadway requires: however, as all future repairs, or such works as

may be necessary to secure permanency, must be done within the tube, I have adopted this size after mature deliberation. It is said, that salt obtained from water taken from the surface of the sea will give a red colour to a blue paper, while salt from deep-sea water, will not alter the colour: the change is caused by the action of an acid, namely, Iodine; and the reason why this acid is found in surface and not in deep-water is, that it is communicated to the water by the atmosphere: hence, the bottoms of iron ships, when the interior skin of the iron is kept clean, and well painted, appear to suffer little or nothing from the action of the water on the exterior: there are, indeed, ships 25 or 30 years old, in the thickness of the plates of which there is no perceptible diminution: thus, without any expense save painting, the Channel Railway will be a perfect work for a long period of years. But, in order to make it a permanent as well as a perfect work, while I propose that for 15 or 20 years from its opening for traffic, the interior of the tube be simply kept clean and well painted, I contemplate the expediency, notwithstanding that the embankment surrounding it will by that time have become perfectly consolidated—perhaps impermeable—of ultimately lining it with brickwork, say to the thickness of 2 feet: this at the price given by Mr. Wylson would cost £689,040. The amount that would be necessary to maintain the ordinary repairs of such a work according to most of the projects proposed, would if set aside accumulate a fund quite sufficient for this purpose.

The material to fill the boxes and form the embankments would amount to 18,700,000 tons, of which would be effective for loading, at least - - - - 5,000,000 tons

The weight of water displaced by 20 miles of a 30-feet tube will be - - 2,080,000 tons

Weight of tube, boxes, and roadway - - - 250,000 „

Leaving an actual buoyancy of - - 1,830,000 „

And a surplus loading of - - 3,170,000 „

This weight equals about 30 tons per foot lineal of the tube: it

will, however, be reduced about 35 per cent. by its own displacement, leaving a really efficient surplus-loading of about 19½ tons per foot, over 2,000,000 tons for the whole length of 20 miles. Chalk will be the best material for both the loading and the embankments, from its accessibility and abundance, its specific gravity being at the same time equal to that of granite or marble —a mean of any of them being about 2·7.

In joining the sections of the tube at a depth of 100 to 120 feet, we will have an end pressure at, say, 50 lbs. per square inch, of 2270 tons, forcing the tubes together; which, with a flange 9 inches wide, gives 486 lbs. per square inch of bearing surface. Suppose we were to use 1¼-inch round bolts, and have them 3 inches apart, we would have 388 in the circumference of 97 feet, which, at 7,500 lbs. per bolt, gives a cohesive power of 2,910,000 lbs.; but, at the depth where the greatest number of joints will be made, we have a cohesive power of 5,083,200 lbs. equal to 673 bolts of 1¼-inch iron. Looking at section Fig. 9, it may be supposed that I have overlooked this immense pressure, from the slender supports which I have there given to the bulkheads, C and D: these supports, however, were only thrown in to indicate the direction of the forces, not the strength of the bulkheads; for these will have the further support of the central partition, girders, and ceiling; all of which, as well as the ribbed inside of the tube itself, will afford full facilities for bracing them sufficiently, to resist any pressure to which they will be subjected. Keeping in view this immense cohesive force, which unites the newly-submerged tube to the portions previously placed—more firmly than the permanent joint subsequently made by bolting the inner flanges together, it is evident that there will be no necessity to delay till the permanent joint is completed before commencing the loading of the tube; but the loading may commence as soon as the primary joining is satisfactory; and materials sufficient to load a length of tube may be ready on the surface of the water, and deposited in the boxes, and around and upon the tube, within twelve hours of the time when those in charge receive orders to proceed. If, on passing into the space between the bulkheads after the water is drawn off,

the primary joining is not found satisfactory—that, though the outer flanges have come together sufficiently fair to exclude the water of the sea, the inner are not sufficiently so to admit of being properly joined, then, by closing the valve and admitting water again between the bulkheads, the cohesive power will be destroyed, and the defects in the joint having been duly noted, such exterior power can be applied through the submerging tackles, as will adjust the ends, and the final withdrawal of the water will enable the permanent joint to be proceeded with.

I readmit the water between the bulkheads (if necessary) through an elbow-pipe, governed by a stop-cock, connecting the section of tube in which we are at work with the bulkhead thereof, and withdraw the air while the division is filling through a pipe in the upper part of the bulkhead. I mention this minor detail as an example; because amongst the scientific and practical men to whom I have introduced my project, some have appeared dubious whenever I omitted to notice such details; not that they stumbled at their difficulty, but that they evidently regarded the omission as an indication that I had only studied the matter superficially, and had not mastered or appreciated all its difficulties; while, on the contrary, I have carefully studied the whole work; and am confident of being able to satisfy all who will give it an ordinary degree of attention, as to its perfect practicability. When examined on the subject by a Commission of eminent Engineers in Paris, who raised with great earnestness such difficulties as their scientific knowledge or practical experience suggested, I had the pleasure of being able to answer to their apparent satisfaction. I might, perhaps, have attempted in these pages something more scientific and descriptive; but this, I conceive was an error which some who preceded me on this subject fell into: a thorough interest in the undertaking must first be awakened, the necessity for it strongly felt, and a desire for its accomplishment take hold of the public mind; in short, it must be a thing accepted, nay, decided on; before a purely practical work on the subject receives attention. If the Channel Railway attains that position in public favour, and receives that attention from those interested—that

countenance from the Governments of England and France to which its important international character entitles it; and this discursive attempt to introduce it meets an encouraging reception, which I sincerely trust it deserves; I purpose making arrangements for treating the subject in a future edition in a manner more commensurate with its importance.

But, to return to the joinings of the tube: on this operation depends the time that will be required to complete the whole work. The time requisite to make the several sections of it will depend on the number of skilled workmen that can be obtained in both countries; and that, therefore, need not be taken into acconnt, seeing that all the sections can be ready long before they would be wanted. But the time required to join one length to those already in position, is the criterion that will decide how long it will take to construct the Channel Railway. My anxiety to draw the reader's attention to this point arises from the fact, that, while it is possible to expedite all other parts of the work by employing powerful and perfect machinery, and increasing the number of hands, there is a limit beyond which this operation cannot be forced; and there are seasons during which, if not simply impossible, it would be at least injudicious and unsafe to attempt to perform it. From careful inquiries made among captains of packet-boats, pilots, coastguards-men, citizens of Dover, and others, I have concluded that from 160 to 200 days in the year, the Channel is sufficiently smooth for submerging, joining, and loading the tubes. These inquiries, however, were principally made during the present summer, and this season, I am informed the sea has been unusually smooth; but, assuming that 120 days will be fine enough for the purpose, and having two points of operations, we can certainly attach a tube to each for every four fine days; thus, the whole connection between the central and the two other ventilators can be effected within two years, and the works between these last and the shores go on, and be completed within the same time. As, however, a section of the tube may be submerged or lowered at the rate of a foot per minute, or even faster; and as we have admitted that it may be loaded down in twelve hours;

and as the works within can go on independently of fine weather above; it is perfectly possible to connect the whole in one fine season: thus, one year, or at most two, from the time of commencing the work of submerging, would see the Channel Railway *un fait accompli.*

The method of joining the tubes under water, is the principal distinctive feature of my project: it is that which renders submarine tubular roadways in positions of great width and depth a possibility: the want of it nullified the plans of other projectors, compelling one to say, "the operation will be attended with no extraordinary difficulty to those who can remain during half-an-hour in deep water;" another, to adopt the proposition of building one tube 20 miles long, and sinking it whole; and the rest, to take shelter in a diving-bell, without showing how they would make it accomplish their object. The principle, then, which I use in joining the tubes —the mechanical law whence I derive the force to unite such immense masses in deep water, is old as Nature itself, and immutable as those principles that work and govern the steam-engine, or the electric telegraph. *I* have not discovered this principle: it has long been known, and its power used in various ways: I have only devised a method of applying it to new works—new purposes, by a simple contrivance, or invention, which will enable man to carry roads across wide and deep rivers, straits, and arms of the sea, heretofore thought impassable; and, at an expense proportionally less than the cheapest description of bridging. The Channel Railway, including four miles of tunnel-approaches, will cost £500,000 per mile, = £94 14s. per foot. The bridges that span the Thames in many instances cost five, and in some cases nearly ten times this amount. This extraordinary economy in expenditure, this almost absurd lowness of cost, is mainly due to the fact that the tube, the principal feature of the work, requires no expensive wrought stone-work, or expensive material to support it, or expensive skilled labour to put such materials together: the embankment of broken stone that completely envelops it has hardly to support any of its weight: its tendency is upwards, pressing against the material above it instead of that below; hence,

the arrangement of the stones below into compact masonry is unnecessary, quantity only being required: they will fall around and beneath the tube, filling up the inequalities of the bottom of the Channel, while the boxes will retain sufficient to prevent its buoyancy from forcing the crown of the embankment.

There are few persons, now-a-days, who will doubt the practicability of constructing iron tubes capable of containing a railway; or, of making them strong enough to resist the pressure to which they would be subjected in deep water: the guiding them correctly to their position under water, the joining them when there, and effectual arrangements for keeping them down, seem to have been wanting hitherto: it has been my study not only to supply these, but to mature and complete a project by which this important work might at once be placed among the realities of the age. Besides the general features discussed in this pamphlet, I have considered means for inspecting the bottom of the Channel; of taking correct measurements of distances therein, and soundings of points at which joinings will be made, provision for depositing the materials of loading and embankment exactly where required, arrangements for submerging tubes, telegraphing from the interior to the vessels above, and other minor details connected with various parts of the work; to treat which at length would require a much larger space, and many illustrations; and would carry me beyond the limits of a preliminary discussion. And why should I discuss details before the principle is accepted? It is now on trial at the bar of public opinion; and were I fond enough to hope that others will regard it with the affectionate interest and attention it has received from me, I would not be uneasy respecting the verdict. In commending my project to the notice of all conditions of men, professional and non-professional, I have spoken in the language of everyday life, for two reasons; first, the professional and general reader alike understand it; the second no careful reader requires: it is unnecessary to tell such why I have not written more technically on the subject.

CHAPTER IV.

ESTIMATES.—DATA, HOW OBTAINED.

BEFORE preparing the following estimates, I corresponded with several of the principal iron manufacturers and merchants in the country; and, taking an average of six lists of prices, I added 25 per cent. thereto before I adopted it as a datum to calculate from. With regard to the labour, I obtained the opinions of several practical engineers; and to the figures of one I added 25, to those of another 50, and to those of a third 100 per cent, and I founded my estimate on the result. I will select one plate of iron as an example: it is the largest and heaviest that will be used in the work; and the quantity of that size required will exceed that of all other sizes combined; nor, with the exception of some angle or T-iron, will any other piece approach it in price, while upwards of 50,000 tons will be at least £4 per ton cheaper. The plate in question will be 9 feet 4 inches × 3 feet, and will weigh 5 cwt. The average of the six prices alluded to for Best Best Boiler-iron, is £10 16s. 8d. for plates of 4 cwt., and £1 extra for each half cwt. additional; the price of the plate referred to will therefore be £12 16s. 8d., to which, if we add 25 per cent., we have £16 0s. 10d. But, if this work is not to form an exception to the customary mercantile rule—viz., that large orders are executed at lower rates than small ones, there is more likelihood of the iron being obtained at 25 per cent. less, than of having to pay 25 per cent. more, than the above price of £12 16s. 8d. Some have expressed fears that a demand so great will disturb the market, and raise the price of iron; but such fears will not for a moment trouble those who know the resources and capabilities of the iron trade. It is more likely, by giving an impetus to production, to lower prices. The quan-

tity required will be spread over several years; and if, in its preliminary stages, the Channel Railway resembles other great undertakings, there will be ample time to make preparation for the increased demand. The estimates given me for labour were from £3 to £6 per ton: I adopted £8, making, with the maximum price for iron, £24 0s. 10d., which I called £25 in round numbers. This does not refer to the boxes surrounding the tube, made of common cheap iron, and not requiring to be water-tight; the iron of these cannot exceed £9, nor the workmanship £3, though I have estimated them together at £16; nor do these calculations refer to the work on the ventilators; for in respect of these, I have added to the maximum price, £10 per ton, in consideration of the great height to which the work will be carried, and the amount of scaffolding that will be required.

Deep-sea ventilator, for 28 fathoms, double iron bottom: diameter 132 feet, area 13,684 × 2 = 27,368 × ½ inch	=	547,360 lbs.
Cellular partitions between and connecting the bottoms, 7,360 feet × 3 feet × ⅜ inch ...	=	331,200 „
Strengthening cross ribs between bottom and level of roadway, 928 feet × 10 feet × ½ inch	=	185,600 „
Outer shaft 387 feet in circumference × 208 feet, in height × ½ inch	=	1,619,920 „
Inner shaft, 251½ feet × 208 feet × ½	=	1,046,240 „
Laps, rivets, stays, roof, and balance of iron-work, say 50 per cent. additional	=	1,865,160 „
		5,595,480 „
		= 2,498 tons.

2,498 tons at £35 per ton	=	£87,430
46,097 cu. yds. stonework, at £5	=	230,485
Filling bottom, launching, &c., ...		100,000
Cost of deep-sea ventilator ...		£417,915
Cost of two ventilators for twelve fathoms, say, ...		£417,915
Total cost of ventilators		£835,830

Brought forward, cost of ventilators,		£835,830
Tubes, in lengths of 400 feet each.		
Tube, laps included, $435 \times 96 \times \frac{1}{2}$ = 835,200 lbs.		
T-iron ribs, two to each plate, $5 \times 5 \times \frac{7}{16}$		
25,200 lineal ft., at 13·75 lbs. per ft. = 346,500 „		
Centre partition, 12,000 ft. × $\frac{5}{16}$ in. = 150,000 „		
T-iron for do. 3,900 lineal ft., at 9·75 lbs., 38,025 „		
333 joint laps for do. ... ... 3,330 „		
Angle-iron, connecting do. with tube, 16,000 „		
Ceiling, 400 feet × 25 × ¼ inch = 100,000 „		
T-iron for do., 2,926 lineal ft., at 8 lbs. 23,408 „		
Girders, 5 ft. apart, 1,920 ft., at 54 lbs. 103,680 „		
Rivets, &c. ... ... 63,857 „		
Weight of tube ... ... 1,680,000 „		
= 750 tons.		
750 tons, at £25 per ton ... = £18,750		
264 tubes, at £18,750	= £4,950,000	
528 flanges for do., at £120	=	63,360
1,320 boxes for stone loading, 23 tons each, at £16	=	485,760
140,000 feet of timber for top frame of do., at 2s.	=	14,000
Submerging 100 mid-channel tubes, at £5,000	=	500,000
Do. 130 in from 12 to 17 fathoms, at £3,000	=	390,000
Do. 34 close in shore, at £2,000 ...	=	68.000
Levelling bottom, loading, and covering tubes, 7,431,108 cubic yards, broken stone, &c., at 5s.		1,857,777
Shore embankments, rough stone, &c., 3,250,000 cubic yards, at 4s.		650,000
Tunnel approaches, say		400,000
Roadway say		100,000
Engines and furnishings of ventilators, ...		30,000
1,000 lamps, at £20, ...	=	20,000
Preliminaries and contingencies, ...		1,635,273
Total estimate, ...		£12,000,000

In preparing the above, I have endeavoured to avoid the error of deceiving at one and the same time my reader and

myself with low estimates; an error into which many of those who have preceded me have fallen, in their anxiety to press their respective projects on public attention. I have, in all cases, exceeded the maximum rate when data were within my reach; and when none could be had, I have, according to the opinions of many practical men, placed my figures much too high. I have never looked upon my project as a haphazard, hit-or-miss, conception, but as a practicable method of accomplishing a great work. I am convinced that the realization of this work cannot be far distant, since the wants, the wishes, the peace, and the prosperity of the two greatest nations on the earth demand it; and, as I might have some duty to perform in connection with its construction, I have endeavoured to make my project as perfect as possible. I feel that on its obvious utility, and on the correctness of my estimates of its cost and probable revenue, must depend its title to consideration.

I will now select a few figures to show the difference between my estimates and those of projectors who have preceded me. M. De Gamond, in estimating the cost of material with which he proposed to form islands in the Channel, allows 5 francs per cubic metre of finished work; and this material was to be of a compact nature, impermeable to water: my estimate for the stone to load the tubes and form the embankment is 5s. per cubic yard, being about 70 per cent. over the estimate of the French Engineer. This part of the work, according to my estimates, will cost £1,857,777, but at his prices, which he characterizes as the maximum, it would cost only £1,114,650. With the same ratio of reduction applied to the whole estimate, my project could be carried out for about £8,000,000, instead of £12,000,000. He has for contingencies 14,000,000 francs: I have 41,000,000. Mr. Wylson estimates iron for tube and ventilators at £20 per ton; I have £25, and £35. The total cost, where estimates are given, varies according to the ideas of the several projectors from 7 to 87 millions sterling. I am aware of only two besides myself that have given detailed estimates:—

M. De Gamond's tunnel (25 francs per £) . . £6,800,000

Mr. Wylson's tube	£15,000,000
My own	12,000,000

As regards the first, where there is any similarity of work, and I can compare his estimates with my own, I find my rates from 70 to 200 per cent. over his. For depositing material in the sea (as already noticed) to form islands, through which he may penetrate into *terra firma*, he allows 5 francs per cubic metre, about 3s. 4d. per cubic yard, at 25 francs per £ sterling. Sinking thirteen wells, or shafts, through this loose deposit in the open sea, from 26 to 192 feet deep, he estimates at 990,000 francs = about £3,000 each; for the tunnel proper he allows, for mining, pumping, ventilating, and removing and depositing material in the sea, 9 francs per cubic metre, about 6s. per cubic yard; for the lining of tunnel, 1 metre thick, he estimates 50 francs per metre, about £1 13s. 9d., per cubic yard; for similar and more accessible work within the ventilators, I allow £5 per cubic yard. Tunnelling under water, especially such deep water as the Straits of Dover, is an undertaking involving considerable risk; and where the distance is great, the risk is more than proportionally increased. The impossibility of ascertaining the exact state and nature of the ground through which the tunnel is to be driven, renders its completion a matter of great uncertainty: ninety per cent. of the work might present no serious difficulty, while the remaining portion might contain sufficient to render its abandonment more profitable than its prosecution. I know of only one instance of tunnelling on a large scale under water—the Thames Tunnel; and though it may be unfair to take this most expensive of tunnels as a criterion for a similar work at the Straits of Dover, I nevertheless think it a safer one than the sanguine estimates of an engineer anxious to secure attention for his project: the great depth to which he must descend, in order to leave sufficient thickness between the arch of the tunnel and the bottom of the Channel, renders long-tunnelled approaches on either shore, necessary to insure easy gradients in reaching the level of the adjacent country; hence M. De Gamond's tunnel is 30 miles, 333 yards in length; now 30 miles at the same cost per mile as the Thames Tunnel (£1,811,292) would give £54,338,760:

if no serious difficulties were encountered it might possibly be done for half this amount; but in a work of such an uncertain nature, no estimates however ample, could be relied on; nor would the guarantee of any contractors, however wealthy, secure shareholders against further calls, to which the wisest could not set a limit: the Channel Railway, on the contrary, may, according to my project, form several separate contracts, the tubes, ventilators, embankments, tunnel-approaches, each, or portions of each, could be placed in the hands of men perfectly responsible; thus, not only insuring completion of the work, but fixing the ultimate cost before a shilling is expended. Mr. Wylson's tube contains accommodation only for a single line; and stops short of either shore; thus, as far as goods traffic is concerned, it would be an aggravation rather than an amelioration of the present system: the cost of a tube large enough for a double line on his plan would probably be about £25,000,000.

With the prices and data obtained from iron manufacturers, engineers, and contractors, I prepared the following Minimum Estimate for connecting the Railways of England and France by a continuous double line according to my project.

202,996 tons, tube and ventilators, at £18 ...	£3,653,928
30,360 do., boxes, at £14	425,040
140,000 feet of timber for ditto, at 2s.	14,000
52,194 yards concrete and masonry, at 60s. ...	156,582
Launching and placing ventilators	150,000
Flanges for tubes	50,000
Submerging 264 tubes, at £2,500 each	660,000
Embankment, covering tube	1,114,650
Rough stone in shore embankments	560,000
Tunnel approaches	400,000
Roadway, engines, and lighting	150,000
Contingencies	600,000
Total	£7,934,200

A single line would cost about three-fourths of the respective estimates; thus, the maximum estimate for a single line would be

£9,000,000, and the minimum £5,960,650. Though these minimum figures are founded on data at least as reliable as any used by other projectors, I do not put them forward as the probable cost of this work; but for the purpose of enabling the reader to compare them with the estimates of others. I adhere to my first or maximum estimate as the safest. In endeavouring to avoid errors in this respect into which, as it appears to me, others have fallen, I may have verged on the opposite extreme by placing my figures too high: however, I prefer, for reasons already given, to come before the public with estimates fully capable of completing the work, rather than bring forward such as might be considered doubtful.

I cannot pretend to speak with the same certainty respecting the following estimates of probable revenue, there being no reliable data on this subject available; and though I feel confident they are within what may reasonably be expected, I frankly admit, that they are founded simply on observations made while trading and travelling between England and France. I published these figures in a brief prospectus of this project some months ago; and I see no reason to alter them now: after I adopted them, I became acquainted with the the work of M. De Gamond; and on comparing figures, found a wonderful coincidence in the items of freight and passengers—

his being	...	...	...	...	...	£1,041,666	13	4
and mine	...	...	...	...	...	1,049,375	0	0

He seems to have overlooked the mails as a source of revenue: his figures were compiled in 1856, and based on the actual business then done between England and the Continent; and as he could not have foreseen the impetus that has since been given to trade and travel between England and France by the recent Treaty of Commerce, and by the amelioration of the passport system, his figures are more sanguine than mine—compiled in 1861, after these important changes had actually taken place.

Estimate of probable revenue:—

2,500 tons freight daily, or 912,500 per annum, at 12s. 6d.	...	...	...	...	...	£570,312	10	0

Brought forward	£570,312	10	0
1,500 passengers daily each way, or 1,095,000 per annum, at 8s. 9d.	479,062	10	0
Mails, express-freight, coin and bullion, extra baggage, &c., say, ...	250,625	0	0
Total annual revenue ...	£1,300,000	0	0

These figures may appear too high to those who have overlooked the affinity between improved means of transit and the increase of traffic resulting therefrom. In the infancy of railway enterprise, the anticipated travel on a given line was based upon the number carried between the termini by the stage-coaches and waggons of the day. I will not insult the understanding of my readers by comparing the anticipated with the actual results of railway traffic; but I may take the liberty of reminding them that our experience in that case did not prevent our falling into a similar error in the case of ocean steamers; and, though fleet after fleet of these vessels have taken their places on the ocean, each creating for itself a trade where none such existed before, I have found this the most difficult point to carry in discussing with parties interested, the subject of railway communication between England and the Continent: I am frequently told "there will not be sufficient trade to make it pay," and when I ask for a reason, I am referred to STATISTICS, as if, like the laws of the Medes and Persians, *they* were unalterable—incapable either of augmentation or of change of ratio—no matter what may be the increased facilities of intercommunication; or, sometimes, I am referred to the Thames Tunnel as a test whereby to establish the probable commercial value of the work in question: I am asked "If the Thames Tunnel, a quarter of a mile in length, connecting two populous districts of a large city at a place where any other roadway is impracticable, will not pay, how can you expect one twenty miles long to pay, where there is a scanty population at either end?" I answer, if the Channel Railway be so constructed that descent into it will, like the Thames Tunnel, be through a well

staircase so situated that travellers will have to employ a guide to show them the entrance; and if, instead of a railway, there be no better travelling accommodation than a footpath, I readily grant that it will not pay; but if, on the contrary, it be made accessible by easy gradients, and capable of accommodating the railway trade of England and the Continent, so that traffic can be maintained between London and Paris, and other English and Continental cities, without change of carriages or locomotives—if instead of employing three vehicles as at present, one only be required, we have but to glance at the effect which increased facilities have already had upon passenger traffic alone in this direction, to be convinced that this will be one of the best paying works undertaken since the era of Railways began. Between 1820 and 1830, in the good old times of sailing packets, the number of travellers between England and the Continent did not exceed 80,000 per annum: the establishing a regular steamboat service raised the number in twelve years to 350,000; and since the introduction of railways it has risen to upwards of a million: this great increase is not to be attributed to the increase of the populations, but mainly to these improvements; and the effects that would result from the completion of this work, would be even greater than were produced by those two important revolutions in locomotion, which respectively raised the figures from 80 to 350 thousand, and from the latter to upwards of a million.

Travel, at present, is checked in this direction by the dread of sea-sickness: when this becomes, as far as the Channel is concerned, a thing of the past, the fetters that have hitherto confined thousands will be broken. Few are willing to admit, even in jest, the simple horror they entertain of this painful malady: a humorous writer, with much truth and some extravagance, says, "The term 'suffering' does not in the least express the mental and bodily agony of my position on shipboard. * * * I am rendered intellectually an idiot, and physically a helpless log:" besides, it is very undignified to be compelled, before a large company, to whine "and ask for drink, like a sick girl." Depend upon it, there are thousands, both in England and on the Conti-

nent, who will never acknowledge it; but who are nevertheless constrained by this bugbear to make the Channel the eastern or western boundary of their travels: "Never, quoth I" (says the same humorous writer), "the last time I was dropped like a sack on Folkestone pier; never, if I know it, and remain in my right mind, do I catch myself on board ship again." We have only to glance at the rates of fares by the different lines to form an idea of the power of this same bugbear, and the effect it has upon the existing passenger traffic; and if we study the matter intelligently, we can form a tolerably correct and interesting estimate of the extent to which it operates as a hindrance. Passing by Southampton and Havre as too extreme for our purpose, the route by Newhaven and Dieppe is certainly the most direct and interesting between London and Paris; and yet, with very little difference in time—really nothing of any value, a day being lost by either—it can command but little over one-third of the Dover and Calais fares, though that by the South Eastern Railway, is the longest of the three principal lines. The cause of this disparity is apparent—short sea voyage, less sea-sickness by the latter: the same cause makes a difference between the Dover-and-Calais, and the Folkestone-and-Boulogne fares, in favour of the former; though the difference in sea-voyage is only a few miles, and the whole distance by the latter route, in reality the shortest.

In order to form some idea of the obstruction which the Channel causes to railway traffic, let us suppose a mound or wall erected athwart, obstructing, and dividing into two separate sections, all the railways connecting London with Manchester, Liverpool, and the North; and that all trains by day or by night, stopped at this wall, and changed their passengers and freight into other carriages; that several valuable but miserable hours were thus wasted, during which passengers dreaded, suffered from, or witnessed upon others, the effects of a terrible malady, compared to which the gout or toothache were a positive amusement; that it cost the companies half the revenue derived from freight to transfer their goods traffic across this wall; that, in short, they knew and felt that this obstruction "hindered them of half their gains." Under such

circumstances, how long, think ye, would this wall endure? Would £12,000,000 be grudged to remove it—to effect an improvement that should add twenty-five, yea, fifty per cent. to the value of say a hundred millions of railway property? The Channel is such an obstruction, cramping a traffic, which untrammelled, would surpass that between London, Manchester, Liverpool, and the North. This obstruction, I have shown can be removed for £12,000,000.

But many, it is said, will not travel under the sea. Neither would they travel under the land until ways were made for them. The idea of going under the sea suggests notions of dampness and wet, as that of going under the earth was suggestive of the dank clammy atmosphere of the tomb. Old ladies going to Bath have been known to make express stipulations that *they* were not to go through the tunnel; but at the proper time the curtains were closed, and the good timid creatures smuggled to their destination. How many will in like manner traverse the haunts of the mermaid—gliding along the Channel Railway—remains to be seen. Of one thing we may be certain, unless there is some great change in human nature, the quickest route will take the passengers, and a trifle will turn the scale. "I remember," said a friend, "seeing an opposition between a steamboat and a railway train. The boat had comfortable state-rooms; the carriages of the train resembled a string of second-hand coffins: the boat fares were somewhat the lowest: their time of departure was late in the evening: the train, if on time, arrived about two in the morning; the boat reached her destination about six. They started; the train was full, the boat nearly empty." Suppose the Channel Railway opened, and two trains leaving London for Paris at 7 A.M. daily; one by the new, and one by the old route; the first landing its passengers at noon, the second at 6 P.M.: which, think ye, is likely to get the most? But even the effect which this work will have on the increase of passengers will be thrown into the shade by the revolution it will create in goods traffic: at some future period I intend to return to this subject, in order to take a statistical and more comprehensive view of the matter. In the mean-

time I will be satisfied if I succeed in attracting the attention of those interested, being convinced that if they take up the question, its importance will secure a careful investigation.

EXPENSES OF MAINTENANCE.

Before proceeding to notice these expenses, I propose that the work be looked upon more in the light of a bridge than as a railway—the company keeping up no rolling stock, but simply charging a toll on the traffic. The anticipated expenditure of coal contemplates the possible necessity for artificial ventilation.

Management, per annum, say	£10,000
20 tons of coal, per diem, at 20s.	7,300
60 men at 5s. per diem	5,675
Wear and tear of engines and machinery	3,000
80 section men at 5s. per diem	7,300
1,000 lamps at £10 per annum	10,000
Repairs, paint, &c., 20 miles at £2,000	40,000
Contingencies	1,725
Total	£85,000
Thus, for an outlay of £12,000,000	
we have an annual revenue of	£1,300,000
Subject to an annual expenditure of	85,000
Leaving a nett revenue of	£1,215,000

being upwards of ten per cent. on the capital. I do not pretend that this would be realized during the first three or four years; though I have no doubt of a revenue sufficient to pay an average of five per cent. per annum being forthcoming even for these years. With the exception of M. De Gamond, the other projectors, as far as I can learn, have not given estimates of revenue and expenditure, apparently taking for granted that the commercial value of the work is sufficiently obvious. This engineer's project contemplated connecting with the existing railways at Boulogne, Calais, and Dover, receiving and handing over passengers and

freight at these points: his tariff was—Passengers, twelve francs each, and ordinary freight twelve, express do. eighty, and extra baggage 100 francs per ton. His interesting calculations embrace a variety of subjects; among othere some illustrating the capabilities of his tunnel to accommodate the growing trade it would create; and the following items which could only be obtained in a country having a passport system. Previous to 1845, the proportions per cent. of English and foreign travellers between England and France were,

English	86
Continentals	14

and since 1845,

English	76
Continentals	24

CHAPTER V.

ADVANTAGES—TO EXISTING RAILWAY COMPANIES,

THE lion's share of the material benefits which the Channel Railway will confer, will fall in the first instance to existing railway companies whose lines terminate at the Straits. If we estimate the value of the lines between London and Paris at £60,000,000, and suppose that their value will be increased £25 per cent. by the completion of this work, their capital will thus be improved to an extent exceeding the total cost of the undertaking. Is this an unreasonable expectation—is it too sanguine to assume that when the traffic on these roads is doubled by an improvement that costs them nothing, they will be able to pay, say five per cent., instead of four: I have no fear of being classed by thinking men as a visionary for stating that I consider it quite likely they will be able to pay six. Nor will improvement in the value of railway property be limited to lines between Paris and London: distance will lessen but not destroy its beneficial influence in this respect; for other lines connecting with these railways, though located beyond London and Paris, will participate in the general increase of traffic; and those terminating at Liverpool, Marseilles, Central Europe, and the North, will experience an improvement second only to the railways having a direct connection. The immense increase of goods traffic which will necessarily accompany the opening of this work, would alone accomplish the above results; and the tolls of the Channel Railway can be paid from such rates as are now paid for ferriage, without encroaching on those of the connecting railways. Thousands of packages sufficiently valuable to pay railway freights, that are now shipped from Continental to British ports direct; and all British exports to France, Central and Northern Europe

(except cheap and bulky goods); would pass over the Channel Railway, contributing to the general railway traffic of England and the Continent. Coin and bullion, to and from all parts of Europe, India, and the East, would also pass over it; and Australian gold, instead of encountering the danger and delays of a passage through the Straits of Gibraltar and the Bay of Biscay, would come by Marseilles and the Channel Railway to London. The saving in interest on the value of merchandise, coin, and bullion, for the difference in time between delivery by this and other routes, and the saving in sea-insurance, would alone be sufficient to secure all the light and valuable and best paying traffic.

The saving of time, and immunity from the mental, moral, and physical wear and tear occasioned by a rough Channel passage, are not the least important of the blessings which the Channel Railway will confer on its patrons. The time saved cannot be reckoned by the simple crossing of the Channel: when the trip to Paris, like that to Manchester, is performed in five hours, and the time table no longer depends on the tide, these hours can be selected from a portion of the twenty-four that will not interfere with the business of the day: true, one can save a day at present by forfeiting his rest, travelling at night, subjecting himself to sundry uncomfortable changes at each side of the Channel and the risk of a drenching in the middle: this saving, however, is not due to the means of conveyance; but, to the self-denial and exertions of the man, who may at any time make an extra day without going to Paris by working all night instead of going to bed.

To go into statistics would carry me beyond the limits I originally intended. I will therefore confine myself to a few figures merely to illustrate the foregoing remarks. The trade between England and France alone, Imports and Exports, amounted in 1859 to £26,432,855, I assume that half of this amount represents goods that could and would pay railway and Channel freights, and that the balance of Europe, the Mediterranean, India, and the East, would combined furnish an amount equal to France: there would then be £26,432,855 on which the merchant would

save sea-insurance, and say two days' interest. The average of coin and bullion carried between England and France for the three years ending 1860, is £17,231,721: supposing all Eastern ports of the world, including India and China, but excluding Australia, could furnish an equal amount, and Australia furnish £10,000,000, we could then have a total of £44,463,442 annually, on which there would be a saving of sea-insurance, and say one day's interest. Assuming the number of travellers to be about a million annually, and supposing the time of one-fourth only to be commercially valuable, ten shillings per day is a low estimate for the time, and ten shillings for expenses saved.

RECAPITULATION.

Increase in value of railways connecting London and Paris with the Channel Railway, say 25 per cent.:—

On 60,000,000	£15,000,000
Increase in value of other English and Continental lines, say £200,000,000 at 10 per cent.*	20,000,000
Permanent increase in value of existing railways	£35,000,000
Two days' interest on value of goods transported, £26,432,855 at 5 per cent.	£7,242
One day ditto on coin and bullion, £44,463,442 at 5 per cent.	6,091
Saving of sea-insurance on coin, bullion, and merchandise, £70,896,497 at $\frac{1}{16}$ per cent. ...	44,310
Saving of time and expenses of, say 252,357 passengers at 20s.	252,357
Annual saving	£310,000;

which, at 5 per cent., represents a capital of £6,200,000, and, with the above increase to value of existing railways, is equal to £41,200,000 permanent increase of property, or an annual revenue

* This result would be obtained, if it enabled roads paying £4 dividends now, to pay £4 8s.

of £2,060,000. Such, at a low estimate, are some of the DIRECT MATERIAL ADVANTAGES which the completion of the Channel Railway will secure to the communities immediately concerned; but who can estimate the value of the INDIRECT—the impetus given to commerce, and through commerce to manufactures, and through both to every interest affecting the weal of the two greatest peoples on the earth? If, then, we shrink from estimating such material concerns as properly come within the province of figures, what shall we say of its influence on religion, science, literature, civilization, and the peace and happiness of the human race.

The capital—how can it be raised? The subscribers—who are they to be—where are they to come from? True, they have come forward in vast numbers in times gone by when Mexico or Mississippi, Illinois or Indiana, Texas or Turkey, wanted funds; but "far away fowls have fair feathers," though many an English heart in distant lands

> "When tuneless birds scream round forlorn,
> Regrets the lark that gladdens England's morn."

Ay, and many an English capitalist to-day can point to large sums in his ledger *once* real assets, *now* simple matter of history connected with a foreign country, and regret that he did not invest in some less inviting but more certain stock nearer home, under his own eye, where no expensive foreign commissions would be required to ascertain the value and condition of his property. But who can undertake a work of such extraordinary magnitude? It is too great for any of the Railway Companies directly interested; perhaps too great for all these companies combined; but, will any one presume to say that twelve millions cannot be raised in France and England, especially when the investment not only gives great promise of a large direct return, but offers, besides, immense collateral advantages to both nations. If a strong company were formed comprising the leading capitalists of the two countries, including those interested in railways directly or indirectly connected, the Governments, between whom a firm friendship happily exists, would doubtless countenance the undertaking. England and

France could not do less to effect this most desirable communication, than England and America were prepared to do for the Atlantic Telegraph. When such a company obtains a charter granting the right of exclusive railway communication between England and France for a term of years, with a promise of aid in men and steamships in forwarding the work, and, perhaps, a guarantee of a minimum dividend on a certain capital for a limited period (and all may be obtained if both nations heartily desire its accomplishment), then the question will not be who will subscribe? but who will get the stock?

Great and influential names are accounted, nay, really are, indispensable to the forwarding of undertakings such as this, though, alas! they are not always certain omens of success. If Government encouragement and support, leading politicians, wealthy bankers, eminent engineers, and great contractors could foreshadow and insure prosperity, the Grand Trunk Railway of Canada should now be one of the best investments of the day. While, therefore, duly appreciating the value of the influence and opinions of those who have earned a title to respect among their fellow-men, I hope all who feel an interest in this important work will endeavour to study and examine the subject for themselves. Though I have been favoured with, and encouraged by, the countenance and advice of several of the leading men of the age, I seek not on that account the good opinion of the public; nor have I asked permission to shelter my project behind the respect which prominent names, political, literary, and scientific, both English and French, could not fail to inspire. Judged solely by its intrinsic merits, I am confident the Channel Railway will soon count among its friends a sufficient number of great names to insure it a place not only among, but at the head of, the wondrous achievements of modern times.

Who should encourage the Channel Railway? The Queen of England. The lives of sovereigns are grand chapters in the histories of monarchical nations: other nations seldom live to have histories worth dividing: true, England's present chapter is already bright beyond historic precedent; and small indeed is the chance left to the clear head, the daring arm, or loyal heart, that

would add a flower to the wreath upon her monarch's brow: still, this enterprise completed in Her day, will shine among the works that grace Victoria's reign, like the Koh-i-Noor among the crown jewels; and the minister who places the gem in her diadem shall fill a place in history second only to the Mistress whose name and glories his action will adorn.

Who should encourage the Channel Railway? The Emperor of the French. He who planted amidst a warlike people an empire of peace—who is to-day devoting to the maintenance of order, to great and useful improvements, such power and energies as are too often devoted to bloody and destructive wars. The noble works which he has given to France in return for her devotion to his person and dynasty, require the fostering influence of peace and commercial prosperity (and this work will aid both,) to develop their value, and elucidate the wisdom that called them into existence. Like the reign of our beloved Sovereign in the history of England, that of her Imperial ally will form a glorious chapter in the history of France. Nor will the completion of this work in his day make that chapter less interesting; and if (which God prevent) that day should close before his son matures to wield his sceptre, he will sleep no less quietly on the banks of the Seine, that the alliance with England, his noblest achievement, has been strengthened by bands of iron.

The Governments and Legislatures of both lands should encourage the Channel Railway. The fruits of their recent legislation are beginning to appear, nay, are already in the market: the trade with France is now making up for the falling off in that with America: the exports to the former during July show an increase of 40 per cent. over the same month last year, while the total exports of the United Kingdom have fallen off 20. If enlightened statesmanship and wisdom actuated both nations in lately removing certain restrictions that hampered trade, they will not fail to remove another more annoying than customs, and tariff regulations; and which has not even the merit of adding a penny to the exchequer of either country. Though these regulations require an inspection of imports, this is generally done where it best

suits the importer; but the Channel *authorities* are not so considerate; goods are peremptorily stopped there, and not a few packages only, but all, subjected to sundry expensive handlings and delays. This serious inconvenience of changing from truck to steamboat, from steamboat to truck, tumbling, rolling, and damaging packages, will increase with increasing traffic to a jam—a nuisance; deranging the movements of trains, and sowing the seeds of future railway accidents; in short, it is the only serious impediment to the blessings expected from recent legislation. The Channel Railway will be useful in peace; in war it would be harmless. Fears have been entertained that it might become an instrument of invasion; but both ends could be furnished with sluices, or valves, the opening of any of which would immediately inundate the roadway, not only preventing invasion, but destroying the army that made the attempt; and after peace was restored, a few days would suffice to restore the communication.

Shareholders of existing railways should encourage this work, especially those of the Northern of France, the South-Eastern, and the London, Chatham, and Dover. If now their dividends are four per cent., it will speedily raise them to five or more. By judiciously encouraging the Channel Railway, a shareholder whose investment of £8,000 now gives him £320 a-year, will raise the former to £10,000 and the latter to £400; nor will he require to wait for the former improvement till the work is completed, its very inception will affect the value of his shares, which will sympathize, and keep pace, with the agitation in its favour. Thus, while advancing his own interest, he will have the satisfaction of lending a helping hand to forward an undertaking that will stand pre-eminent among the works of man.

The friends of peace should encourage the Channel Railway. By binding us more firmly to the nations of Europe it will increase the horrors and evils of war, and strengthen the desire of all nations to prevent it. England has for upwards of forty years strenuously refused to quarrel with the United States; not that she has feared them, but because the trade with America has been a necessity to her manufacturing interests. So will the trade with

Europe, especially with France, speedily become. Manufacturers have two grand necessities, a supply of raw material, and a market for manufactured goods; the latter doubtless the most important. The raw material, even in the case of articles with strong local peculiarities (as regards production), like cotton, may spring from many sources, and be the produce of "poor naked wretches," serf, semi-savage, or slave; but a market for manufactured goods must be found where the means exist to pay for them. When this great work has made commerce with the nations of Europe a necessity to the manufacturing interests of England, we will be chary about provoking a European war, or of raising a barrier between our trade and our customers by quarrelling with France. When France sees her railway system become the nucleus of the commerce and travel of Europe; when her neighbours east and west pay transit tolls on traffic passing through her borders, and she is thriving by their prosperity as well as her own; if such wisdom continue to guide her councils as happily directs them now, her soldiers will be employed as conservators of peace, not myrmidons of war. When England and France, having a mutual interest in the peace of Europe, have their glorious alliance strengthened by the iron bands of the Channel Railway, other nations will pause before disturbing that peace, and incurring the displeasure of powers which, thus united, may dictate terms to the world.

All good and great men should encourage the Channel Railway. If improvements in locomotion are held to be blessings; if railways and steamboats have promoted the interests of commerce and manufactures, and opened new sources of comfort and happiness to mankind; then should the Channel Railway be encouraged.

CHAPTER VI.

CONCLUSION.—EXISTING WORKS NO CRITERION.

When new and extraordinary enterprises are first introduced, men whose time is much occupied, and such as cannot or will not give attention to extraneous matters however important, expect to find conclusive data provided for them; and if these data, from their extent and nature, demand much attention, they expect *their* essence in the shape of tangible comparisons with other works. But comparison with anything existing would be of no avail in *describing* a work like this, and would be worse than useless in assisting us to ascertain its commercial value: there is really nothing that could be pressed into any degree of usefulness in this respect, by any combination of facts or figures. But the Channel Railway would be the principal highway between Europe and America, monopolizing the traffic in valuable goods, passengers, and mails: if now such traffic to a great extent flow east and west through English ports, who can imagine the increase that would follow the opening of this work? Liverpool would then be to Europe what she is now to England. Nor while gainers ourselves would our neighbours lose: the way to India and the East would then be established through France; and when a better transit across the Isthmus of Suez was completed, thousands of tons that now find their way round the Cape would go by Marseilles. Besides the increase of traffic on her railways, France would have within her borders a strong guarantee of peace with England. And what effect would this work have on her relation to the countries of Central Europe? Men would still ship bulky, heavy, and cheap goods from Bremen, Hamburg, and the Baltic; but the light and valuable, the best paying articles of commerce, would find their way westward

through France, and *vice versa*. The traffic of all lines connecting with this work on both sides of the Channel would receive an impetus, the full extent of which it would be rashness to speculate upon. What would have been thought of any person who, thirty years ago, had predicted the increase of traffic that has followed the introduction of railways? Even in the nineteenth century, among the most enlightened nations of the world, he would have been overwhelmed with ridicule, derision, and scorn. But, in this age, at this date, thanks to the great and convincing proofs of the triumphs of mind over matter in the shape of steamboats, railways, and electric telegraphs—to the liberal, scientific, and commercial education within the reach of many, and last, though not least, to the increased facilities for the diffusion of knowledge there exists a prescient class of men, not easily appalled by anything that can be done or man may dare to do: to such, I respectfully commend the Channel Railway.

"Forty-five thousand men will never make England powerful on the Continent," was frequently said by the first Napoleon—a saying the truth of which is generally admitted. Diplomacy may obtain for a people a temporary ascendancy, but the wise head is not immortal, and no nation has a monopoly of wisdom. Learning, perhaps, may make a nation great and respected? Yes, if it has made Greece so: if wisdom saved Venice, or arms saved Rome, then arms, diplomacy, and learning may secure a high place among the nations; but, if these fail to procure the respect due to a great and powerful people, FREEDOM, INDUSTRY, and their fruit —WEALTH, command a respect never accorded to mere learning—such as diplomacy cannot acquire, nor the force of arms compel. These great blessings, our birthright, privilege, and reward, are not to be used for our own exclusive advantage; we have them and hold them on behalf of the human race, and can only expect a blessing with them while used in accordance with the Divine charter that placed them in our hands. England has no cause to blush on account of her martial, political, or literary sons; but as a manufacturing, trading nation, her mission is commercial; and commerce is happily not limited to what we shall eat, drink, or

wear. The arts and sciences, learning, and manners are also commercial commodities; and these as well as the necessaries of life, with increasing facilities of intercommunication will develop their latent vigour and utility. The importance of France as a mart for the former has already been hinted at, and is too apparent to require further mention; for the latter, no nation offers such advantages of interchange. If our neighbours excel in the fine arts, we excel in the useful. Is their learning deep and refined? ours is general and utilitarian. Does their politeness sometimes put us in the shade? perhaps we have some countervailing advantage. If the civilising influence of two such peoples is now felt throughout the world, what may be expected when this great work draws the bond of union closer between them?

In connection with its commercial and civilizing influence on the nations let us glance at the item of expenditure. England and France have, within the last hundred years, expended more in attempts at mutual destruction than would build a hundred works like the Channel Railway; and who can tell what its influence may be in averting future wars? If it were the means of shortening by only one month, such wars as these nations with improved implements of warfare are now prepared to wage, that alone would amply pay for its construction. Wars are sometimes undertaken to maintain a nation's rights; they are more frequently waged to vindicate some nice, but often worthless point of national honour, when they become duelling on a grand scale. The bloodiest of European wars have been fought to maintain, or rather obtain the balance of power: in each, and all of these, efficiency to destroy has been the first consideration, expenditure the last; but when works of this kind claim attention, the great, the good, the noble, the civilizing, nay, even the MATERIAL ADVANTAGES, are all crowded into the background, expenditure alone receiving due, or rather undue, prominence; though a tithe of the millions spent in war if thus appropriated, would give a larger return in all that tends to make a people great, to vindicate their honour, and strengthen their voice among the nations.

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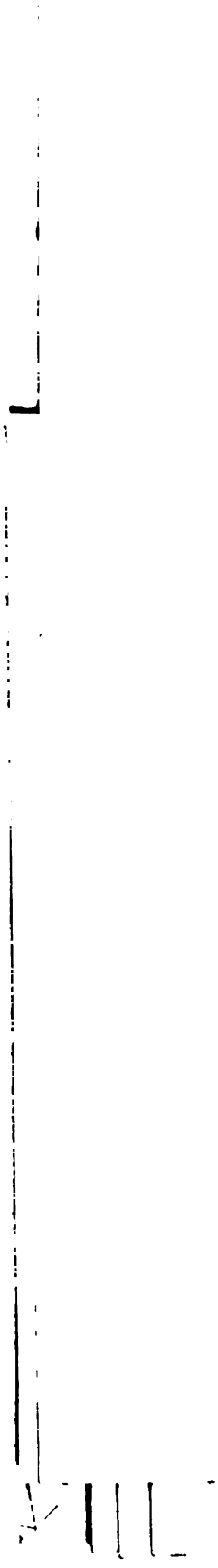

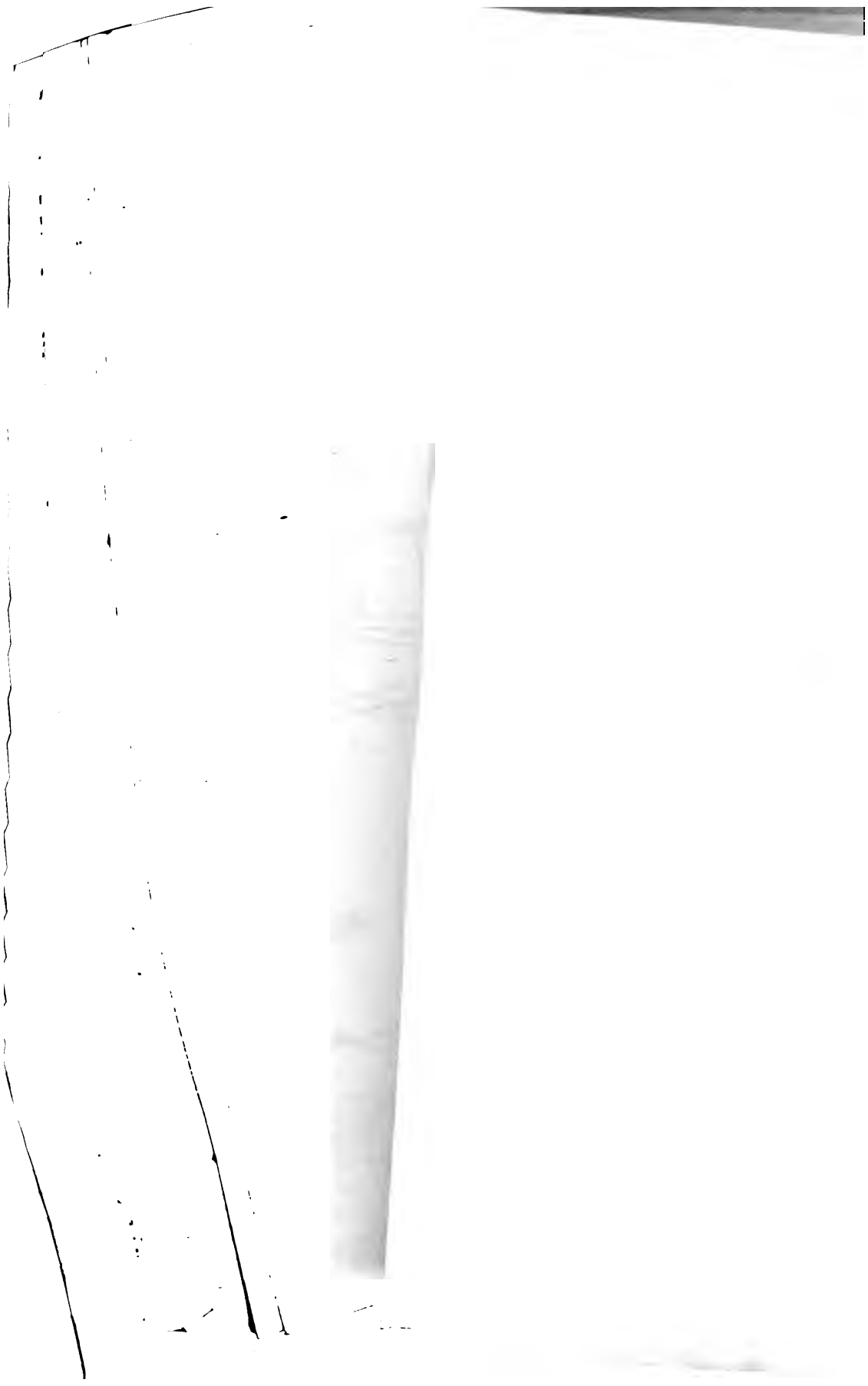

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